

Colorfastness to Crocking: AATCC Crockmeter Method

Developed in 1936 by AATCC Committee RA38; revised 1937, 1952, 1957, 1961, 1969, 1972, 1985, 1988, 1996, 2004, 2005; reaffirmed 1945; 1989; editorially revised and reaffirmed 1968, 1974, 1977, 1981, 1995, 2001; editorially revised 1986, 2002. Partly equivalent to ISO 105-X12.

1. Purpose and Scope

1.1 This test method is designed to determine the amount of color transferred from the surface of colored textile materials to other surfaces by rubbing. It is applicable to textiles made from all fibers in the form of yarn or fabric whether dyed, printed or otherwise colored. It is not recommended for use for carpets or for prints where the singling out of areas may be too small using this method.

1.2 Test procedures employing white test cloth squares, both dry and wet with water, are given.

1.3 As washing, drycleaning, shrinkage, ironing, finishing, etc., may affect the degree of color transfer from a material, the test may be made before, after, or before and after any such treatment.

2. Principle

2.1 A colored test specimen is rubbed with white crock test cloth under controlled conditions.

2.2 Color transferred to the white test cloth is assessed by a comparison with the Gray Scale for Staining or the Chromatic Transference Scale and a grade is assigned.

3. Terminology

3.1 **colorfastness**, n.—the resistance of a material to change in any of its color characteristics, to transfer of its colorant(s) to adjacent materials, or both, as a result of the exposure of the material to any environment that might be encountered during the processing, testing, storage or use of the material.

3.2 **crocking**, n.—a transfer of colorant from the surface of a colored yarn or fabric to another surface or to an adjacent area of the same fabric principally by rubbing.

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedure

and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practices should be followed. Wear safety glasses in all laboratory areas.

5. Apparatus and Materials

5.1 AATCC Crockmeter (see 13.2, 13.3 and Fig. 1).

5.2 Test Cloth, cut in 50 mm squares (see 13.4).

5.3 AATCC Chromatic Transference Scale (see 13.5).

5.4 Gray Scale for Staining (see 13.5).

5.5 White AATCC Textile Blotting Paper (see 13.5).

5.6 Specimen Holder for Crockmeter (see 13.3).

6. Verification

6.1 Verification checks on the operation of the test and the apparatus should be made routinely and the results kept in a log. The following observations and corrective actions are extremely important to avoid incorrect test results where abnormal crock images can result and influence the rating process.

6.2 Use an in-house poor crocking fabric as a calibration specimen and conduct three dry crock tests.

6.2.1 A poor circular image with uneven dye pick-up may indicate the crocking finger needs resurfacing (see 13.6).

6.2.2 A double, elongated image may indicate a loose clip (see 13.6).

6.2.3 A stretched and streaked crock image may be due to mounting the crock square diagonally.

6.2.4 Scuff marks to the sides of the specimen indicate the loops to the wire clips are positioned downwards and are not high enough to prevent rubbing the specimen surface.

6.2.5 A streak in the center of the crock cloth image and in the direction of rubbing may mean the top of the metal base is warped and not flat. This will require a brace insert to square up the tester base.

6.2.6 If specimen holders are used, place the holder over the specimen on the tester base. Move the crocking finger on the crocking arm to the most forward position and observe whether it hits the inside edge of the holder. If this occurs, move the holder slightly forward for all tests. Without correction, this problem will cause a dark area on one side of the crocking image.

6.2.7 Confirm the wet pick-up techniques (see 9.2).

6.2.8 Replace the abrasive paper on the tester base if it is smooth to the touch in the crocking area compared to the adjacent area, or if slippage of the specimen is noticed (see 13.7).

6.2.9 In routine testing, observe if multiple streaks are on the crocking image. Position specimen normally with the long dimension oblique to the warp and filling. If the direction of rubbing falls along a twill line or surface pattern, etc., then streaks may occur. If they do occur, slightly adjust the angle for testing.

7. Test Specimens

7.1 Two specimens are used, one each for the dry and the wet tests.

7.1.1 Additional specimens may be used to increase the precision of the average (see 12.1).

7.2 Cut specimens at least 50 × 130 mm (2.0 × 5.1 in.) and position for testing preferably with the long dimension oblique to warp and filling or wales and courses.

7.2.1 Larger or full width lab samples may be used without cutting individual specimens, when multiple tests are needed and when using for production testing.

7.3 Yarns. Knit a piece of fabric at least 50 × 130 mm, or wind yarn tightly on a



Fig. 1—Crockmeter.

suitable form at least 50 × 130 mm with the yarn running in the long direction; or otherwise stretched (see 13.8).

8. Conditioning

8.1 Prior to testing, precondition and condition the test specimens and the crock squares for crock testing as directed in ASTM D 1776, Conditioning Textiles for Testing. Condition each specimen for at least 4 h in an atmosphere of 21 ± 1°C (70 ± 2°F) and 65 ± 2% RH by laying each test specimen or crock square separately on a screen or perforated shelf of conditioning rack.

9. Procedures

9.1 Dry Crocking Test.

9.1.1 Place a test specimen on the base of the Crockmeter resting flat on the abrasive cloth with its long dimension in the direction of rubbing (see 13.6 and 13.7).

9.1.2 Place specimen holder over specimen as an added means to prevent slippage.

9.1.3 Mount a white test cloth square, the weave parallel with the direction of rubbing, over the end of the finger which projects downward from the weighted sliding arm. Use the special spiral wire clip to hold the test square in place. Position the clip with loops upward. If the loops point downward they can drag against the test specimen.

9.1.4 Lower the covered finger onto the test specimen. Beginning with the finger positioned at the front end, crank the meter handle 10 complete turns at the rate of one turn per second to slide the covered finger back and forth 20 times. Set and run the motorized tester for 10 complete turns. Refer to individual specifications for any other required number of turns.

9.1.5 Remove the white test cloth square, condition (see 8.1) and evaluate as directed in Section 10. In the case of napped, brushed or sanded material when loose fiber might interfere with the rating, remove the extraneous fibrous material by pressing lightly on the crock circle with the sticky side of cellophane tape before evaluating.

9.2 Wet Crocking Test.

9.2.1 Establish technique (see 13.10) for preparing wet crock cloth squares by weighing a conditioned square, then thoroughly wet out white testing square in distilled water. Prepare only one square at a time.

9.2.2 Weigh dry crock square. Using a syringe tube, graduated pipette or automatic pipetter, draw up water in mL to 0.65 times weight of crocking square. If crocking square weight equals 0.24 gm, the mL used would be 0.24 × 0.65 = 0.16 mL. Lay crocking square on white plastic mesh over a dish. Apply water evenly

over crocking square and weigh the wet square. Calculate wet pickup according to instructions in AATCC Methods 8 and 116, Colorfastness to Crocking test methods. If needed, adjust the amount of water used to wet the square and using a new crocking square, repeat steps. When 65 ± 5% wet pickup is achieved, record the amount of water used. Draw up the recorded amount of water into the syringe tube, graduated pipette or automatic pipetter for each wet crocking performed during the current day. Repeat this process each day.

9.2.3 Avoid evaporative reduction of the moisture content below the specified level before the actual crock test is run.

9.2.4 Continue as directed in 9.1.

9.2.5 Air dry the white test square, then condition (see 8.1) before evaluating. In the case of napped, brushed or sanded material when loose fiber might interfere with the rating, remove the extraneous fibrous material by pressing lightly on the crock circle with the sticky side of cellophane tape before evaluating.

10. Evaluation

10.1 Rate the amount of color transferred from the specimen to the white test square under examination by means of the Chromatic Transference Scale or the Gray Scale for Staining (see 13.11 and 13.14).

10.2 Back the test square with three layers of white test cloth while evaluating.

10.3 Rate dry and wet crocking fastness by means of the Gray Scale for Staining or the 9-step AATCC Chromatic Transference Scale. (Usage of these scales is discussed in AATCC Evaluation Procedures 2, 3 and 8, respectively.)

Grade 5—negligible or no color transfer.

Grade 4.5—color transfer equivalent to Step 4-5 on the Gray Scale for Staining or Row 4.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 4—color transfer equivalent to Step 4 on the Gray Scale for Staining or Row 4 on the 9-step AATCC Chromatic Transference Scale.

Grade 3.5—color transfer equivalent to Step 3-4 on the Gray Scale for Staining or Row 3.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 3—color transfer equivalent to Step 3 on the Gray Scale for Staining or Row 3 on the 9-step AATCC Chromatic

Transference Scale.

Grade 2.5—color transfer equivalent to Step 2-3 on the Gray Scale for Staining or Row 2.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 2—color transfer equivalent to Step 2 on the Gray Scale for Staining or Row 2 on the 9-step AATCC Chromatic Transference Scale.

Grade 1.5—color transfer equivalent to Step 1-2 on the Gray Scale for Staining or Row 1.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 1—color transfer equivalent to Step 1 on the Gray Scale for Staining or Row 1 on the 9-step AATCC Chromatic Transference Scale.

10.4 Average individual results to the nearest 0.1 grade when multiple specimens are tested or when a panel of evaluators rate color transfer.

11. Report

11.1 State whether dry or wet crocking test.

11.2 Report the grade determined in 10.3.

11.3 Report the grade determined in 10.4 to the nearest 0.1 grade.

11.4 State whether Gray Scale for Staining or Chromatic Transference Scale was used for evaluating staining (see 13.5, 13.9).

11.5 If any pretreatment or aftertreatment was given to any specimens (see 1.3) indicate method of treatment.

12. Precision and Bias

12.1 *Precision.* An interlaboratory test was conducted in 1986 to establish the precision of the test method. Testing was conducted under the normal atmospheric conditions of each laboratory and not necessarily under ASTM standard conditions. Two operators at each of 12 laboratories evaluated 5 fabrics in 3 replications by both dry and wet test method. Each of 3 raters independently rated the stained crock squares using both the Gray Scale for Staining and the Chromatic Transference Scale. The original data is on file at the AATCC Technical Center.

12.1.1 The components of variance as standard deviations of the Gray Scale for Staining or Chromatic Transference Scale rating units are given in Table I.

12.1.2 Critical differences are given in Table II.

Table I—Components of Variance

| Test Scale | Dry | | Wet | |
|-----------------------|-----------|------|-----------|------|
| | Chromatic | Gray | Chromatic | Gray |
| Single Operator/Rater | 0.20 | 0.20 | 0.24 | 0.25 |
| Within Laboratory | 0.20 | 0.19 | 0.31 | 0.34 |
| Between Laboratory | 0.10 | 0.17 | 0.38 | 0.54 |

Table II—Critical Differences

For the components of variance in Table I, two averages of observed values should be considered significantly different at the 95% probability level if the difference equals or exceeds the following critical differences.

| Test Scale | No. of Observations | Dry | | Wet | |
|-----------------------|---------------------|-----------|------|-----------|------|
| | | Chromatic | Gray | Chromatic | Gray |
| Single Operator/Rater | 1 | 0.55 | 0.54 | 0.68 | 0.70 |
| | 3 | 0.32 | 0.31 | 0.39 | 0.40 |
| | 5 | 0.24 | 0.24 | 0.30 | 0.31 |
| Within Laboratory | 1 | 0.77 | 0.75 | 1.08 | 1.17 |
| | 3 | 0.60 | 0.61 | 0.93 | 1.02 |
| | 5 | 0.60 | 0.57 | 0.90 | 1.00 |
| Between Laboratory | 1 | 0.82 | 0.89 | 1.53 | 1.90 |
| | 3 | 0.69 | 0.77 | 1.43 | 1.81 |
| | 5 | 0.66 | 0.74 | 1.41 | 1.79 |

The critical differences were calculated using $t = 1.96$ which is based on infinite degrees of freedom.

Table III—Crock Test Results

| | Dry | Wet |
|------------|-----|-----|
| Lab A | 4.5 | 3.5 |
| Lab B | 4.0 | 1.5 |
| Difference | 0.5 | 2.0 |

12.1.3 Example for determining between laboratory differences using one observer and the chromatic scale are given in Table III.

Interpretation: For the dry crock test, since the difference between labs is less than the critical differences in 12.1.2 (0.82), the difference in results is not significant. For the wet crock test, since the difference between labs is greater than the critical difference (1.53), the difference in results is significant.

12.2 *Bias*. The true value of colorfastness to crocking can only be defined in terms of a test method. Within this limitation, this test method has no known bias.

13. Notes

13.1 For carpets, AATCC Method 165, Colorfastness to Crocking: Carpets—AATCC Crockmeter Method, under the jurisdiction of Committee RA57, Floor Covering Test Methods, should be used.

13.2 The AATCC Crockmeter provides a reciprocating rubbing motion simulating the action of a human finger and forearm.

13.3 The AATCC Crockmeter is so designed that the 16 ± 0.3 mm (0.625 ± 0.01 in.) diameter finger moves back and forth, with

each complete turn of the crank, in a straight line along a 104 ± 3 mm track on the specimen, with a downward force of $9 \text{ N} \pm 10\%$ ($2 \text{ lb} \pm 10\%$). Two models, a manual and a motorized Crockmeter are available from SDL Atlas L.L.C., 1813A Associate Lane, Charlotte NC 28217; tel: 704/329-0911; fax: 704/329-0914; e-mail: info@sdlatlas.com.

13.4 Crockmeter Test Cloth is available from Testfabrics Inc., P.O. Box 26, 415 Delaware St., W. Pittston PA 18643; tel: 570/603-0432; fax: 570/603-0433; e-mail: testfabric@aol.com; Textile Innovators Corp., div. of SDL Atlas L.L.C., P.O. Box 8, 101 Forest St., Windsor NC 27983; tel: 252/794-9703; fax: 252/794-9704; e-mail: tic@sdlatlas.com.

13.4.1 Crockmeter Test Cloth should meet the following specifications:

| | |
|---------------|---|
| Fiber | 100% 10.3-16.8 mm combed cotton staple, desized, bleached, with no optical brightener or finishing material present |
| Yarn | 15 tex (40/1 cotton count), 5.9 turns/cm "z" |
| Thread count | 32 ± 3 warp ends/cm: 33 ± 3 picks filling/cm |
| Weave | 1/1 plain |
| pH | 7 ± 0.5 |
| Mass/sq meter | 113 ± 5 g greige: 100 ± 3 g finished |
| Whiteness | $W = 80 \pm 2$ (Method 110) |

13.5 The Chromatic Transference Scale, Gray Scales for Staining and White AATCC Textile Blotting Paper are available from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org.

13.6 Accidental damage to the rubbing finger, spiral clip or abrasive paper should be repaired as follows: neatly renew the abrasive paper; bend the clip further open or shut around a rod slightly smaller in diameter than

the crock peg; resurface the finger by movement on an extra piece of fine emery cloth in a manner simulating regular use.

13.7 The abrasive material currently supplied with the Crockmeter is "Wet or Dry Waterproof Silicon Carbide, W-320-A, Soft Back." Replacement pieces are available from SDL Atlas L.L.C., 1813A Associate Lane, Charlotte NC 28217; tel: 704/329-0911; fax: 704/329-0914; e-mail: info@sdlatlas.com.

13.8 For more convenient crock testing of multiple strands of yarn or thread a dowel attachment is useful. This attachment was developed to avoid the tendency of the standard finger to dig into and push aside the yarns, or slide off them and possibly give erroneous results. This attachment is 25 mm in diameter by 51 mm long. Positioned on its side and held in place by the standard finger, it provides a wider test area, and holds the white test square by two spring loaded clips. For additional information on this development see the article by C. R. Trommer, "Modification of the AATCC Crockmeter for Yarn Testing," *American Dyestuff Reporter*, Vol. 45, No. 12, p357, June 4, 1956; also see articles by S. Korpanty and C. R. Trommer, "An Improved Crockmeter for Yarn Testing," *American Dyestuff Reporter*, Vol. 48, No. 6, p40, March 23, 1959. A yarn testing finger kit for installation on the Crockmeter is available from SDL Atlas L.L.C., 1813A Associate Lane, Charlotte NC 28217; tel: 704/329-0911; fax: 704/329-0914; e-mail: info@sdlatlas.com.

13.9 It has been noted that different grades may result depending upon whether the Gray Scale for Staining or Chromatic Transference Scale is used for the evaluation. It is, therefore, important to report which scale was used.

13.10 Experienced operators do not have to repeat this weighing procedure during a test session once the technique is established.

13.11 For very critical evaluations and in cases of arbitration, grades must be based on the Gray Scale for Staining.

13.12 For a discussion of crock testing, see the article by J. Patton, "Crock Test Problems can be Prevented," *Textile Chemist and Colorist*, Vol. 21, No. 3, p13, March 1989; and "Testing for Crocking: Some Problems and Pitfalls" by Allan E. Gore, *Textile Chemists and Colorists*, Vol. 21, No. 3, p17, March 1989.

13.13 For prints where the singling out of areas too small to test with the standard AATCC Crockmeter is necessary, see AATCC Method 116, Rotary Vertical Crockmeter Method. Specimens tested by both test methods may show dissimilar results. There is no known correlation between the two methods.

13.14 An automated electronic grading system may be used as long as the system has been demonstrated to provide results that are equal to and provide equal or better repeatability and reproducibility than an experienced grader performing visual evaluation.